The development and validation of an implicit measure based on biospheric values

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Abstract

Explicit measures of environmental views can be affected by social desirability and cognitive biases. Implicit measures, which should avoid such issues, have previously faced difficulty in establishing balanced and representative stimuli. Recently, measuring environmental views has shifted towards using environmental values, rather than attitudes. Accordingly, this paper outlines a novel approach to implicit measures of environmental views using the Implicit Association Task (IAT). Stimuli representing Egoistic and Biospheric value orientations were selected, having positive valance and categorical representation. Across three independent samples (total n = 293), this Environment IAT (1) showed expected positive correlations with explicit measures of environmental values and attitudes, (2) reflected significant differences between environmentalists and non-environmentalists, and (3) was a unique predictor of environmentalist status even after controlling for explicit values and attitudes. Implications of the Environment IAT suggest a new research approach to environmental preferences for predicting behaviour, and the automatic formation of attitudes.

Introduction

To establish how people view issues related to the environment, a wealth of different measures have been created; Dunlap and Jones (2002) considered "at least 700-800" (p. 493) published measures of environmental views in a comprehensive review. Within the multitude of measures of environmental views, one measure has emerged as the most popular: The New Environmental Paradigm (Dunlap & Van Liere, 1978). The New Environmental Paradigm can be seen as a reaction to societal views that focused on promoting economic success and materialism – the Dominant Social Paradigm in Dunlap and Van Liere's (1978) terms. Dunlap and Van Liere (1978) formulated 12 questions that challenged facets of the Dominant Social Paradigm, measuring attitudes toward ecological limits to growth, preserving the balance of nature, and rejecting human exceptionalism over nature. Updated 20 years later, Dunlap, Van Liere, Mertig, and Jones (2000) published the New Ecological Paradigm (NEP), extended to 15 questions with additional measures of belief in an eco-crisis, and whether industry was exempt from ecological concerns. Since the original publication, the old and revised scales have become the most popular measures of environmental worldviews, with good evidence of cross-cultural applicability and validity (Dunlap, 2008; Hawcroft & Milfont, 2010).

Despite the impressive history of the NEP, recent research suggests a shift in focus from environmental *attitudes* toward environmental *values* (Dunlap, 2008; Steg & Nordlund, 2012). In a recent comparison of values, environmental impact concern, and NEP scores, values were generally a stronger predictor of environmental activism, policy acceptance and personal norms than attitudes (Steg, De Groot, Dreijerink, Abrahamse, & Siero, 2011). An attitude may be defined as "a summary evaluation of an object or thought", temporarily retrieved from pre-held views (Bohner & Wänke, 2002, p. 5). Values, on the other hand, are generally seen as a more stable long-term construct (Stern, 2000) which, varying in strength, act as guiding principles in life (Schwartz, 1992). Values are a useful construct for environmental concern because of their efficiency: there are a smaller number of values than environmental topics (Dunlap & Jones, 2002), and their abstract nature means the same underlying value can be linked to a range of applications (De Groot & Thøgersen, 2012). Another reason to shift focus to values is because they are more stable properties of the people being studied. Attitudes are effectively products of values (Stern & Dietz, 1994), making values the more fundamental and unshifting unit of analysis – in much the same way that it is useful to study the underlying cycles of climate when we want to predict the more superficial patterns seen in weather.

The role of environmental values largely stems from the work of Schwartz (1992, 1994), who demonstrated the international existence of a two-dimensional framework of values. One axis of the two-dimensional grid indicates values for Conservatism (e.g., security and tradition) against values relating to Openness to Change (e.g., autonomy and independence). The second, orthogonal, axis contrasts Self Enhancement (e.g., personal gain,

power and wealth) against Self-Transcendence (e.g., universalism and benevolence) orientations (Schwartz, 1994). This second axis is especially important for environmentalism, since self-transcendence values have been a useful predictor for environmental behaviours by a number of researchers (see De Groot and Steg, 2007). Moreover, a recent meta-analysis collating 13 reports of materialistic values (strongly linked to self-enhancement) found a moderately strong link between materialism, lower environmental concern and anti-ecological behaviour (Hurst, Dittmar, Bond, & Kasser, 2013).

Expanding the use of values, Stern and colleagues (Stern and Dietz, 1994; Stern, Dietz, & Kalof, 1993) proposed an additional value orientation directly related to pro-environmental views. In several studies and reviews, they suggested that while people may wish to protect the environment for altruistic reasons, they may show concern directly for the environment without human interests. Stern and Dietz (1994) offer the example of choosing between protecting people's jobs or protecting historic woodland, both of which are apparently incompatible but which would fall under the same self-transcendence value orientation in the original Schwartz framework. Amalgamating concepts previously discussed by several authors, Stern and his co-authors (Stern & Dietz, 1994; Stern et al., 1993) proposed a tripartite model of value orientations to explain environmental behaviour: Egoistic (concern for yourself), Altruistic (concern for others), and Biospheric (concern for nature).

To address a lack of data on such tripartite models, De Groot and Steg (2008) used a selection of terms from Schwartz's (1992) original values to develop a Value Orientation measure that allowed for the clear separation between the three values. Their Value Orientation measure uses 13 value constructs that participants rate, on a 9-point scale, to indicate how important each value construct is to themselves (including a way of indicating the value opposed to their own values). The 13 items collapse to give a score for each of the three value orientations. The measure has received good support, with results suggesting it is valid across five countries (De Groot & Steg, 2007).

Implicit Approaches to the Environment

Measures of environmental attitudes and values conventionally use survey-type approaches and rely on explicit measures. However, several authors have found people's responses to climate change and environmental issues are easily biased by cognitively available information (Durfee, 2006; Joireman, Barnes-Truelove & Duell, 2011; Viscusi & Zeckhauser, 2006), making the validity of explicit measures of environmental concern questionable. Additionally, several authors have suggested that measuring environmental attitudes may be open to social desirability biases (Beattie & Sale, 2009; Bruni & Schultz, 2010; Ewert & Galloway, 2009; Fischer, Peters, Vávra, Neebe, & Megyesi, 2011; Oerke & Bogner, 2011). Perhaps most obviously seen in the phenomenon of "greenwashing" – the promotion of sustainable

credentials without actual environmental benefits (Pearse, 2012) – social desirability may also influence individual people to promote their beliefs and values as more environmentally conscious than they really are when completing surveys. Social desirability bias is often seen as two variants: self-deceptive positivity, which distorts a person's self-presentation, or impression management to other people, which is more deliberate and can occur without internal change (Paulhus, 1991). It remains unclear whether biases in environmental self-report measures can be characterised as self-deceptive positivity (people viewed by Fischer et al., 2011, as "fallible, but ultimately well-meaning" – p. 1029), or bias for impression management, in which people are "green fakers" (Beattie & Sale, 2009, p. 203). It is also possible that explicit measures of attitudes and values bias responses because they have a simple prompting effect, encouraging people to agree with ideas made cognitively available by the researcher, but which they would not have spontaneously raised themselves, thereby artificially increasing apparent levels of concern (Hafner, Walker, Verplanken & Skippon, in prepA).

Investigating this putative social desirability bias may be possible by comparing explicit and implicit preferences for environmental issues. De Houwer, Teige-Mocigemba, Spruyt, and Moors (2009) suggest the defining characteristic of implicit measures is that they capture automatic assessments of stimuli, rather than reasoned assessments. Typically, implicit measures use computer tasks that measure the speed for a person to associate two stimuli, inferring that this constitutes an implicit measure of association (Teige-Mocigemba, Klauer, & Sherman, 2010). Measuring a person's implicit preferences is appealing, since it can avoid several complications of conventional explicit measures (Teige-Mocigemba et al., 2010), including limits to introspective ability (Nosek, Greenwald, & Banaji, 2007), and issues with social desirability bias (Greenwald, Poehlman, Uhlman, & Banaji, 2009).

However, in contrast to the range of explicit environmental measures, such as the NEP and the de Groot and Steg (2007) Value Orientation measure, there are very few implicit measures related to the environment. One implicit measure compared preferences towards products with low carbon footprints (e.g., modern fluorescent lightbulbs) against high carbon footprints (e.g., older incandescent lightbulbs) as a proxy for environmental concern (Beattie & Sale, 2009). However, this approach relies on participants' awareness of the product's environmentally friendly nature, and some items may have caused confusion (e.g., pineapples were compared to apples for the carbon cost of transport, with no certainty that laypeople would know about such differences). An alternative measure by Schultz, Shriver, Tabanico, and Khazian (2004) examines implicit connectedness to nature. Using a variation of implicit methodology, participants classified words representing 'nature' (e.g., birds, trees) or 'built' (e.g., factory, street), selected for their "face validity" (Schultz et al., 2004, p. 34). This implicit 'connectedness to nature scale' has seen some positive results; implicit connections to nature increased after experiencing pleasant natural environments (Schultz & Tabanico, 2007), and

during typically pleasant seasons (Duffy & Verges, 2010). Yet the measure has been criticised for using overly positive items that might skew results in favour of attachment to nature: Verges and Duffy (2010) reversed the direction of effects in a series of experiments by using positive words for the built environment (e.g., toy, trophy) and negative natural words (e.g., fungus, bee). A rebuttal from Bruni, Chance, Schultz, and Nolan (2012), using their own experimental manipulation of word valance, suggested no differences or reversal in scores, and this debate is likely to continue.

Complications of environment-based implicit measures largely stem from two factors. First, the majority of implicit measures require a binary separation (e.g., Black or White) or a continuum (e.g., Rich to Poor) with clearly defined opposites to contrast against (Lane, Banaji, Nosek, & Greenwald, 2007). Unfortunately, there is no clear opposite to 'environmental concern', with many related words also lacking clear opposites (consider the word 'ecology'). Research into implicit measure methodology emphasises the importance of categories, and misidentification of categories by participants can induce large variations in scores (Brendl, Markman, & Messner, 2001; Teige-Mocigemba et al., 2010). The second complication is the need for valance-balanced stimuli. People appear to have a bias towards stimuli with positive connotations, meaning that category items in an implicit task need to have neutral valence (all stimuli evoke neither positive nor negative evaluations) or, at least, balanced valence, such that for each positive word in one category there must be an equally positive word in the other category. The key issue to avoid would be where the stimuli in one category inadvertently had very different connotations to those in the other (e.g., *lambs*, *flowers*... used as environmental stimuli against *filth*, *squalor*... as non-environmental stimuli). Although such examples are extreme, this issue has arisen in research, whereby stimuli chosen as counterparts to environmental words have strong negative connotations (e.g., pollution, deforestation) which can lead to biased results (Verges & Duffy, 2010), and may even reverse the direction of implicit measures (Govan & Williams, 2004).

Given these issues with previous attempts at implicit measures, we suggest that progress might be made by shifting attention from attitudes and to value preferences. In particular, we note that, given its clear divide between Egoistic and Biospheric values, the work by De Groot and Steg (2007, 2008) may serve as the ideal framework to guide development of an implicit measure of environmental concern. To the best of our knowledge, there are currently no implicit measures based on value orientations. In a conceptual review on value research, Maio (2010) notes that researchers have often considered values as conscious, easily accessible constructs, but that it may be time to explore them using implicit methods. However, Maio (2010) reports three main difficulties in applying implicit methods to value measurement: the need for opposing categories, the range of values that fit under one orientation, and the use of good/bad in implicit tasks while values are measured on importance. For the first two problems,

we believe that the De Groot and Steg (2008) framework can act as the foundation for an implicit measure. To create opposing orientations, Egoistic and Biospheric values may reflect two contrasting influences on pro-environmental behaviour (de Groot & Steg, 2008), with egoistic influences linked to reduced environmental views (Hurst et al., 2013), and that value orientations can act in opposition (Maoi, Pakizeh, Cheung, & Rees, 2009). Additionally, in order to define the complexity of values in an implicit measure, the items used by de Groot and Steg (2007, 2008) provide several items that have successfully represented Egoistic and Biospheric orientations, and may be contrasted in an implicit measure.

The third complication highlighted by Maio (2010) is the use of importance ratings to measure values, while implicit measures are often applied using good/bad contrasts (Teige-Mocigemba et al., 2010). Discussed in more detail in the method section, using basic good/bad assessments can capture automatic preferences, while using more complex terms (i.e., "important" or "unimportant") may reduce the effectiveness of implicit measures (Nosek & Hansen, 2008). For the purposes of this investigation, a good/bad assessment was applied to stimuli, and not ratings of importance, to encourage more automatic responses. This effectively means that we cannot claim that such an approach constitutes an implicit measure of values, but rather would measure an implicit preference toward value orientations. Though our test might not be a direct measure of values, it may nevertheless be possible to infer that a preference toward Biospheric values may be linked to greater concern for the environment.

In summary, then, we suggest that implicit measures have much to offer the study of environmental psychology as they overcome such issues as self-presentation biases, even if these are unconscious. Moreover, we suggest that using values rather than attitudes as the basis for such a measure (in particular the Value Orientation measure from De Groot and Steg, 2008) offers a novel approach to implicit tasks that may prove useful in assessing people's environmental preferences. This paper therefore presents the first investigation into whether implicitly measuring preferences for Egoistic and Biospheric values is a feasible approach.

Method

For this paper, the Implicit Association Task (IAT; Greenwald et al., 1998) was selected as the implicit method. In brief, the IAT typically requires participants to classify word stimuli into two groups. The original version used flowers against insects (targets), and good against bad (attributes). In one block of trials, participants paired flower stimuli with 'good' stimuli and paired insect stimuli with 'bad' stimuli. The task then changed, so insect stimuli must be paired with 'good' stimuli. The speed with which a target can be paired with one attribute is compared to the speed with which it can be paired with the opposite attribute to infer implicit preferences. A person showing a consistent advantage when pairing *rose* with *good* and a consistent disadvantage when pairing *daffodil* with *bad*, whilst at the same time finding it easy to pair

wasp with *bad* but not *beetle* with *good*, would emerge as having an implicit preference for flowers over insects.

There were three main reasons for using the IAT. First, the IAT has proved extremely popular since its inception. Over 450 publications have directly used or evaluated the method (Teige-Mocigemba et al., 2010), with a vast amount of research evaluating the methodology and verifying IAT results across a range of topics (Greenwald et al., 2009; Hofmann, Gawronski, Gschwendner, Le, & Schmitt, 2005). Second, the IAT appears to outperform alternative implicit approaches, reporting larger effect sizes (De Houwer et al., 2009) and with stronger reliability and stability (Bar-Anan & Nosek, 2012). Third, IAT effects are based upon parent categories, and are less influenced by the specific stimuli used (De Houwer, 2001; Mitchell, Nosek, & Banaji, 2003; Nosek, Greenwald, & Banaji, 2005) – which is clearly a desirable property in a psychometric test. This issue is particularly important here, since we are attempting to use the relatively abstract concepts of Egoistic or Biospheric values, which need to be clearly defined for participants without introducing any confounding effects such as a priming effect through the process of definition.

When constructing the IAT, several sources were consulted to establish the strongest possible approach. For the number of trials (stimuli for classification) and overall structure of the IAT, Greenwald, Nosek, and Banaji (2003) advise seven blocks of trials for participants, and that Block 4 includes 40 trials, reducing order effects when switching categories (Nosek et al., 2005).

Table 1: Outline structure of the Implicit Association Task (IAT)

Block	Number of Trials	Left Key Response	Right Key Response
1	20	Category A	Category B
2	20	Good	Bad
3	20	Category A + Good	Category B + Bad
4	40	Category A + Good	Category B + Bad
5	40	Category B	Category A
6	20	Category B + Good	Category A + Bad
7	40	Category B + Good	Category A + Bad

Ordering of categories first with left or right key responses was randomised following advice from Nosek et al. (2005), and timing between trials set at 150ms (Greenwald et al., 1998).

Stimuli

Given the advised minimum of four items to represent a category in IATs (Nosek et al., 2005), five items per category were used. Using the Value Orientation measure (De Groot & Steg,

2008) as inspiration, a set of words was prepared to represent value constructs; for example, De Groot and Steg's value "*Influential: having an impact on people and events*" (p. 337) led to our using the words "Reputation" and "Prestige" as stimuli connoting social power. Seven such words were chosen to reflect values for each category in pilot testing. Five words for Egoistic values and four for biospheric values came from De Groot and Steg's (2008) questionnaire; the remainder came from consulting colleagues and thesauruses with a view to the words' face validity.

Two important factors for IAT stimuli are valance and representation (Lane, Banaji, Nosek, & Greenwald, 2007): sets of stimuli must be of largely equal valance (positive or negative emotive connotations of the stimuli), and must clearly represent their intended categories. To evaluate the suitability of the draft stimuli, a pilot survey study was designed. Respondents were asked to rate each draft word using the ANEW methodology (Bradley & Lang, 1999), with each word rated on a nine-point scale for how Happy/Sad the word made them feel. Participants then classified words as either "Care for Yourself" or "Care for the Environment", and were given space to discuss any complications they encountered. The sample for this pilot work was recruited online using social media website Reddit.com. Using online samples is becoming more popular in social sciences. Online samples – and Reddit.com in particular – have been found to increase diversity in participant samples, while maintaining good reliability and correlations with traditional laboratory samples (Casler, Bickel, & Hackett, 2013; Goodman, Cryder, & Cheema, 2013). The pilot survey attracted 113 responses, though 30 people failed to complete all tasks, leaving 83 valid responses. The stimuli pilot sample was mostly female (63.9%), with a mean age of 24.8 years (SD = 6.9).

Results indicated that words were strongly representative of their categories, with all words sorted into the expected category (care for self or care for environment) by at least 97% of respondents. No participants reported difficulties when categorising words. Valance results were collated, and two words for Egoistic values ("Authority" and "Dominance") scored below the midpoint value of 5, suggesting negative valance. To compensate, two high-valance words for Biospheric values ("Environment" and "Renewable") were removed, leaving two final sets of five stimuli. Valance of chosen items, and combined valance words are shown in Table 2.

Table 2: Mean valance ratings (out of 9) for individual stimuli, and for general categories representing Egoistic and Biospheric values

Egoistic Values (M = 5.54, SD = 1.52)			Biospheric Values (M = 6.22, SD = 1.5)		
Item	M	SD	Item	M	SD
Ambition	6.07	1.63	Recycle	6.12	1.58
Prestige	5.65	1.68	Ecosystem	6.07	1.42

Money	5.17	1.64	Conservation	6.03	1.52
Reputation	5.13	1.13	Natural	6.40	1.37
Leadership	5.69	1.54	Sustainable	6.47	1.60

Although Biospheric words have a slightly higher overall mean valance than Egoistic words, both sets contain only positively valenced items.

For the attribute stimuli, measures of values are based on unipolar measures of importance, while implicit tasks predominantly use a bipolar measure of good/bad (Maio, 2010). Some authors have suggested that implicit measures may employ more complex assessments, such as using "I like" or "I don't like" to measure a respondent's specific assessment of implicit stimuli (Olson & Fazio, 2004), and it may be possible to apply "important" or "unimportant" attributes in an implicit task. Investigating the effectiveness of the IAT using more complex attributes, however, increased the amount of conscious processing of test stimuli (Nosek & Hansen, 2008), reducing the value of the IAT as a measure of automatic preferences. In order to preserve automatic assessment of the stimuli, it was decided that the current approach would employ good/bad assessment. Conventional implicit methods use nouns or verbs (e.g., Love or Hate) to assign ratings, though there was a risk these could be confused with the target stimuli. To avoid confusion, adjectives were used for attribute stimuli (e.g., "Wonderful" or "Revolting"), and were differentiated from target stimuli by randomly using either blue or black fonts for each set (De Houwer, 2001) i.e., attribute words were coloured blue, with target words shown in black, or vice versa, for each participant.

The IAT as formulated here should provide a score of zero for a person equally balanced between Egoistic and Biospheric items, with a positive score in a person whose Biospheric-item preference outweighs their Egoistic-item preference, and a negative score showing the opposite pattern. Greenwald et al. (2003) provide guidelines for interpreting the magnitudes of IAT scores, roughly comparable to Cohen's *d* effect size. Values more extreme than ±0.15 show implicit preferences greater than 'small', .35 for 'medium', and .60 for 'large'.

Validating Implicit Methods

Based on Teige-Mocigemba et al. (2010), two approaches were selected to establish the validity of this new Environment IAT. First, IAT effects should be correlated, in part, with explicit measures. The relationship between implicit and explicit measures across a range of topics was found in a meta-analysis to fall around r =.24 (Hofmann et al., 2005), and a large-scale analysis of online reports found a relationship of r =.36 (Nosek, 2005). Both reports conclude that implicit approaches capture a related, but separate, construct to conventional explicit measures. For our Environment IAT, in which higher scores reflect a preference towards Biospheric values, we would thus expect negative correlations with explicit Egoistic values, and positive correlations with explicit Biospheric values of around this $r \approx .30$ range. Ideally, the IAT should

also show non-significant or weakly positive correlations with explicit Altruistic values (De Groot & Steg, 2008). The Environment IAT should also positively correlate to some extent with unrelated measures of environmental worldviews, such as the NEP (Dunlap et al., 2000).

A second approach to validity is using known-group preferences, where groups are assumed to differ *a priori* on a chosen measure (Teige-Mocigemba et al., 2010). For this study, it was decided that membership of an environmental organisation (e.g., WWF or Greenpeace) would likely reflect stronger environmental values and so provide a group that should differ from non-members on the Environment IAT.

Study 1

For the first test, which was essentially a pilot study, a small and accessible sample was used to establish whether the method could demonstrate the desired effects.

Participants

Participants were recruited from two sources: undergraduate students taking part for course credits, and members of university environmental groups. A total of 42 participants were recruited; 18 were members of environmental groups (16 female, mean age = 20.71, SD = 1.61), and 24 were non-members (17 female, mean age = 18.75, SD = 0.68).

Method

Participants were informed they were completing a study on environmental attitudes and would take part in a reaction speed 'game'. Participants completed the value orientation measure (De Groot & Steg, 2008), the NEP (Dunlap et al., 2000), and were asked their gender and age. Participants also indicated whether they were active members of, or donated money to, environmental groups (giving WWF and Greenpeace as examples). The IAT was constructed using E-Prime v.2.0.8 (Schneider, Eschmann, & Zuccolotto, 2002), and explicit/implicit task order counterbalanced across participants, completed in a laboratory setting.

Results

Explicit measures were calculated, with good Cronbach's alpha scores: NEP $\alpha = .80$, Egoistic $\alpha = .77$, Altruistic $\alpha = .83$, and Biospheric $\alpha = .92$. IAT scores were calculated using the Greenwald et al. (2003) *D* algorithm. Correlations are shown in Table 3.

*Table 3: Study 1 Correlation between explicit Values, NEP, and Environment IAT. * p<.05, **p<.01*

	Egoistic	Altruistic	Biospheric	NEP
Altruistic	-.13			
Biospheric	-.14	.58**		
NEP	.09	.28	.55**	
IAT	-.32*	.31	.48*	.36*

Mean NEP scores differed between the 18 environmentalists (M = 5.48, SD = 0.55) and 24 non-environmentalists (M = 4.71, SD = 0.49) using an independent samples t-test, t(41) = 4.79, $p < .001$; the effect size was conventionally 'large', Hedge's $g = 1.46$ (95% CI: 1.31, 1.62).

Group differences for explicit value importance were compared using independent samples t-tests. Egoistic values for environmentalists (M = 4.56, SD = 1.12) and non-environmentalists (M = 5.29, SD = 1.22) were equivalent, t(40) = 1.96, $p = .108$, as were altruistic values for environmentalists (M = 7.67, SD = 1.10) and non-environmentalists (M = 6.98, SD = 1.21), t(40) = 1.97, $p = .056$. Biospheric values for environmentalists (M = 7.82, SD = 1.12) were higher than non-environmentalists (M = 5.53, SD = 1.20), t(40) = 6.50, $p<.001$, with a conventionally 'large' effect size, Hedge's $g = 1.98$ (95% CI: 1.63, 2.32).

In keeping with this difference in explicit Biospheric values, comparison of IAT scores between environmentalists (M = 0.47, SD = 0.38) and non-environmentalists (M = -0.09, SD = 0.40) was also significant, t(41) = 4.40, $p<.001$; environmentalists had a stronger implicit preference for Biospheric values than non-environmentalists. The effect size for this difference was also conventionally 'large', Hedge's $g = 1.4$ (95% CI: 1.27, 1.52). All p-values have been corrected for multiple comparisons using the Holm-Bonferroni method.

Study 1 Discussion

Study 1's results demonstrate that using words relating to Biospheric or Egoistic values in an IAT produced significantly different scores between environmentalists and non-environmentalists. Environmentalists, who had stronger explicit Biospheric values than non-environmentalists, showed significantly stronger implicit preferences for Biospheric-value-related words than for Egoistic-value-related words. IAT scores also correlated as expected with explicit measures: a negative link to Egoistic values, positive links to Biospheric values and the NEP, and a non-significant link to Altruistic values.

Study 2

Encouraged by results from Study 1, a second study was designed to replicate Study 1 in a larger and potentially more representative sample by using an online approach.

Method

Participants were recruited by advertising the study on social news site Reddit.com. The study was advertised as research on environmental issues, including a reaction speed 'game'. Participants were directed to a website describing implicit attitudes and the purpose of the study. The website also acted as a counterbalancing mechanism: the link to take part in the study randomly assigned participants to either the implicit or explicit section first. The survey was identical to Study 1, with additional questions on respondents' primary language and country of residence. English as first language was required to avoid confusion with words, and since there is some suggestion that language may influence IAT results (Ogunnaike, Dunham, &

Banaji, 2010). No monetary incentive was offered, but participants could receive feedback upon request. The online IAT was based upon a modified 'Open Source, Web-based IAT' JavaScript code (Mason & Allon, 2013).

Participants

In total, 154 participants attempted the study, though 33 respondents failed to complete one or other of the tasks, and 11 did not speak English as a first language, leaving 110 valid responses. Of the 110, 51 were female (46.4%) with a mean age of 25.7 years (SD = 9.3). As an internet sample, respondents were asked which country they were currently living in; 63% were from the USA, 15% from the UK, 7% from Canada, 3% each from Australia and the Netherlands, with remaining participants from Austria, Mexico, New Zealand, Portugal, Singapore, Sweden and Switzerland. As in Study 1, participants were separated based on membership/contributions to environment groups. Twenty-eight participants were environmentalists (10 female, mean age =31.4, SD = 13.4) and 82 were non-environmentalists (41 women, mean age = 23.8, SD = 6.7).

Results

Explicit measures were calculated, with good Cronbach's alpha reliability: NEP α = .87, Egoistic α = .74, Altruistic α = .84, and Biospheric α = .93. IAT scores were calculated using the Greenwald et al. (2003) *D* algorithm, and results correlated in Table 4.

*Table 4: Study 2 Correlation between explicit Values, NEP, and Environment IAT. * p<.05, **p<.01*

	Egoistic	Altruistic	Biospheric	NEP
Altruistic	.01			
Biospheric	-.03	.57**		
NEP	-.30**	.29**	.59**	
IAT	-.34*	.24*	.26**	.28**

NEP scores for the 28 environmentalists (M = 5.50, SD = 0.67) and 83 non-environmentalists (M = 4.72, SD = 0.90) using an independent samples t-test were significantly different, t(108) = 4.16, p <.001. Effect size was conventionally 'large', Hedge's g = .91 (95% CI: 0.76, 1.1).

Group differences for explicit value importance were compared using independent samples t-tests. For Egoistic values, environmentalists (M = 4.60, SD = 1.06) and non-environmentalists (M = 4.94, SD = 1.30) were equivalent, t(108) = 1.24, p = .432, and the same was found for Altruistic values (environmentalists M = 7.31, SD = 1.16; non-environmentalists M = 7.03, SD = 1.42) t(108) = 0.95, p = .346. Biospheric values for environmentalists (M = 7.94, SD = 0.97) and non-environmentalists (M = 5.99, SD = 1.85) were significantly different, t(108) = 5.21, p<.001, with a conventionally 'large' effect size, Hedge's g = 1.15 (95% CI: 0.83, 1.46).

Comparing IAT scores for environmentalists (M = 0.36, SD = 0.41) and non-environmentalists (M = 0.03, SD = 0.55) using an independent samples t-test found a significant difference, $t(108) = 2.91$, $p = .012$. Effect size was conventionally 'medium' to 'large': Hedge's $g = 0.63$ (95% CI: 0.54, 0.73). Again all p-values were corrected.

Study 2 Discussion

Using a larger online sample, Study 2 replicated the difference in IAT scores between environmentalists and non-environmentalists, showing people who had made strong real-world environmental commitments also held implicit and explicit preferences for pro-Biospheric values. Compared to Study 1, results were more mixed, with smaller group differences on IAT and NEP measures, and weaker correlations between the IAT and explicit measures. This may be due to uncontrollable environments participants experienced when performing the online IAT: music, disturbances, or uncertainty of test parameters for example. Also, given the abstract nature of categories within the IAT, greater attention may be required to accurately categorise stimuli, which may also be influenced by such varied environments. However, results overall remain positive: the IAT correlations complied with our theoretical predictions, and medium to large differences in implicit preference were observed.

Study 3

With promising results from Study 1 and 2, a third sample was recruited to further test the validity of the Environment IAT. Although Study 2 provided a large sample with results that supported Study 1, and although online recruitment methods have received support (Casler et al., 2013; Goodman et al., 2013), a conventional recruitment approach may be required as an additional check of validity. To pre-empt any discussion that the online method may not provide sufficient support, a larger sample with physically present participants was sought.

Method

Using the online IAT described in Study 2, two sources of recruitment were used. First, staff within a UK university were recruited using advertisements for a new measure of environmental views, with an open prize draw for £10 vouchers as incentive. Second, visitors to a UK university open day were invited to take part; similar to Study 2, participants were informed they were taking part in a test of implicit preferences, given a link to randomly complete the explicit and implicit tasks in a counter-balanced order, and then offered the chance to receive feedback on their scores at a later date. The survey used the value orientation measure (De Groot & Steg, 2008) and the NEP (Dunlap et al., 2000), as well as recording age, gender, and membership status of environmental organisations, and the order of explicit/implicit tasks was counterbalanced.

Participants

From the university staff sample, 37 participants completed the survey; 23 (62.2%) were female with a mean age of 31.8 years (SD = 8.3). The open day sample had 126 responses logged, though 23 failed to complete either the explicit or implicit sections. Of the 103 valid responses, 74 (72.5%) were female, with a mean age of 28.3 years (SD = 15.9). Combining the samples led to a total of 140 people, 97 (69.3%) of whom were female, with a mean age of 29.3 (SD = 14.4). Of the 140, 16 were members of environmental groups (mean age = 35, SD = 13.8, 12 female) and 124 were non-members (mean age = 28.9, SD = 14.4, 87 female).

Results

Explicit measures showed good reliability: NEP α = .80, Egoistic α = .74, Altruistic α = .81, and Biospheric α = .91. The Greenwald et al. (2003) algorithm calculated *D* scores. Correlations are shown in Table 5.

*Table 5: Study 3 Correlations between explicit Values, NEP, and Environment IAT. * p<.05, **p<.01*

	Egoistic	Altruistic	Biospheric	NEP
Altruistic	.26**			
Biospheric	.13	.58*		
NEP	-.22*	.24*	.41*	
IAT	-.20*	.09	.19*	.28**

Comparing NEP scores for the 16 environmentalists (M = 5.4, SD = 0.69) and 124 non-environmentalists (M = 4.8, SD = 0.74), an independent samples t-test found a significant difference t(138) = 3.209, p = .008. The effect size was conventionally 'large', Hedge's g = 0.81 (95% CI: 0.69, 0.93).

Ratings of explicit values between groups were compared using independent samples t-tests. For Egoistic values, environmentalists (M = 4.39, SD = 1.14) and non-environmentalists (M = 5.26, SD = 1.22) were different, t(138) = 2.70, p = .024, with a conventionally 'medium' to 'large' effect size, Hedge's g = 0.71 (95% CI: 0.51, 0.92). Altruistic values for environmentalists (M = 7.48, SD = 1.62) and non-environmentalists (M = 7.07, SD = 1.32) were not significantly different, t(108) =1.15, p = .253. Biospheric values for environmentalists (M = 7.39, SD = 1.61) and non-environmentalists (M = 6.16, SD = 1.64) were significantly different, t(108) = 2.83, p=.02, a conventionally 'medium' to 'large' effect size, Hedge's g = 0.75 (95% CI: 0.48, 1.02).

Finally, IAT scores for environmentalists (M = 0.389, SD = 0.49) and non-environmentalists (M = 0.015, SD = 0.55) were significantly different: t(138) = 2.58, p = .022, a conventionally 'medium' to 'large' effect size Hedge's g = 0.68 (95% CI: 0.59,0.77). All p-values are corrected for multiple comparisons.

Combined Sample Analysis

For a general overview of the Environment IAT, and to increase sample size to improve statistical power, respondents from all three studies were combined into one dataset. In total, 293 participants completed the IAT; 183 were female (62.5%) with a mean age of 26.5 years (SD = 11.9). The sample was divided into two groups: environmentalists (n = 60, 60.7% female, mean age = 28.9, SD = 12.4) and non-environmentalists (n = 233, 62% female, mean age = 25.9, SD = 11.7). Using the combined sample of all participants, logistic regression analysis was used to predict environmentalist status. Five predictors were included in the model: each of the three explicit value orientations from De Groot and Steg (2008), NEP score (Dunlap et al., 2000), and the Environment IAT effect. Using a stepwise (Forward Likelihood Ratio) approach to determine predictor strength using data-driven criteria, results from the logistic regression are shown in Table 6.

*Table 6: Combined sample (N = 294) logistic regression predicting environmentalist status, * = p<.05, ** = p<.001. Pseudo-R^2 = .26 (Cox & Snell), .40 (Nagelkerke), Final model fit $X^2(4) = 85.45$, p <.001*

	B	S.E.	Wald	Exp (B)	Low 95%	High 95%
Step 1						
Biospheric	0.82	0.13	37.46**	2.27	1.75	2.96
Constant	-7.13	1.02	49.01**	0.00		
Step 2						
Biospheric	0.85	0.14	39.22**	2.34	1.79	3.05
Egoistic	-0.61	0.15	16.06**	0.54	0.40	0.73
Constant	-4.38	1.15	14.57**	0.01		
Step 3						
Biospheric	0.80	0.14	34.19**	2.22	1.70	2.89
Egoistic	-0.55	0.16	12.49**	0.58	0.42	0.78
IAT	1.04	0.37	7.79**	2.83	1.36	5.86
Constant	-4.50	1.14	15.57**	0.01		
Step 4						
Biospheric	0.67	0.15	20.74**	1.94	1.46	2.59
Egoistic	-0.47	0.16	8.49**	0.63	0.46	0.86
IAT	0.99	0.38	6.73**	2.68	1.27	5.65
NEP	0.65	0.30	4.81*	1.92	1.07	3.44
Constant	-7.34	1.76	17.37**	0.00		

Logistic regression results suggest the best predictors of environmentalist status, in decreasing order of strength, were Biospheric values, Egoistic values, IAT score, and finally the NEP. In the final model, 47.5% of environmentalists were correctly identified, and 95.2% of non-environmentalists accurately identified. Environmentalists made up only 20% of the sample, so the 47.5% correct classification demonstrates the model has truly identified aspects of the measures that predict environmental commitment better than chance.

As an additional test, the Environment IAT was assessed as a unique predictor of environmentalist status, after accounting for variation explained by the conventional measures of all three value orientations and NEP scores. A binary logistic regression model, predicting environmentalist status, was run in two steps: Step 1 included NEP and the 3 value orientations measures as predictors, and the second added the Environment IAT as a predictor, to assess the possible improvement of the model. The Step 1 model showed a significant fit of $X^2(4) = 84.39$, $p < .001$, pseudo-R^2 = .25 (Cox & Snell), .40 (Nagelkerke). Adding IAT in Step 2 showed a significant increase in model fit ($\Delta X^2 = 7.01$, $p = .008$), with an overall model fit of $X^2(5) = 91.40$, $p < .001$, pseudo-R^2 = .27 (Cox & Snell), .43 (Nagelkerke). The analysis indicates that the Environment IAT is a unique predictor of environmentalist status even after accounting for the conventional measures of environmental preferences using value orientations and environmental worldviews.

General Discussion

This paper describes the design and validation of an implicit measure based on environmental values. The Environment Implicit Association Task (IAT; Greenwald et al., 1998) is based upon the theoretical framework by Stern and colleagues (Stern & Dietz, 1994; Stern et al., 1993) identifying three value orientations linked to environmental behaviour: Egoistic, Altruistic, and Biospheric values. De Groot and Steg (2007, 2008) developed a reliable explicit measure of these three value orientations, which inspired a set of original stimuli for the Environment IAT developed here. Stimuli were evaluated to ensure that IAT items strongly represented the opposing value orientations of Egoistic and Biospheric values, and had limited valance imbalance. Using the IAT across three separate studies, medium to large differences in implicit preferences were found between actively committed environmentalists and non-environmentalists, and IAT effects correlated as predicted with explicit measures of values and with environmental worldviews. When predicting membership of environmental organisations, the implicit approach proved a significant predictor of who was and was not a member of an environmental group, even after controlling for explicit values and attitudes.

When developing their value orientation measure, De Groot and Steg (2008) noted that Biospheric and Egoistic values may have opposing influences on environmentally sustainable behaviour, given their representation of Schwartz's (1992) polarised self-enhancement/self-transcendence value orientations. In all three studies presented here, IAT scores (where higher scores indicate a preference for the environment over the self) were negatively correlated with explicit Egoistic values, and positively correlated with explicit Biospheric values, supporting the Egoistic/Biospheric contrast. Additionally, IAT scores were not significantly correlated with explicit Altruism scores in Study 1 and 3, and were positively correlated in Study 2. De Groot and Steg (2008) demonstrated that Altruistic and Biospheric values are separate but

closely linked, indicating that the IAT successfully differentiated between Altruistic and Biospheric values in two of the studies, but remained linked to Altruistic values in Study 2. Also, IAT results in all three samples showed positive correlations with the NEP, measuring a person's explicit environmental worldview (Dunlap et al., 2000). The positive correlation with a secondary measure gives additional support to the IAT, suggesting that it measures some shared variance between implicit preferences and explicit views. Validation of the IAT was also found in its ability to identify group differences. Using membership of an environmental organisation (e.g., Greenpeace or WWF) for categorisation, the three studies showed that environmentalists held stronger implicit preferences for environmental values than the general population – a clear example of criterion validity. Calculating effect size between groups and using Cohen's (1988) guidelines, the difference in implicit preference was conventionally 'medium' to 'large' in all three samples.

Conventional explicit approaches using the value orientation measure (De Groot & Steg, 2008) and the NEP (Dunlap et al., 2000) both performed well, showing medium to large effect size differences between the groups. In the combined analysis of all participants (n = 293), the three explicit value orientations, IAT scores, and NEP scores were included in a logistic regression to predict membership of environmental groups. When controlling for explicit value measures, the IAT remained a significant predictor of environmentalist status, supporting the validity of using the Environment IAT approach to capture additional variation within behaviour over and above what can be captured through explicit methods (Greenwald et al., 2009). Additionally, the explicit value measure for Altruism was not a significant predictor of group status, again supporting the idea that Biospheric values are a separate construct, uniquely linked to environmentalism and not merely a manifestation of more general concern for others (De Groot & Steg, 2007, 2008; Stern & Dietz, 1994; Stern et al., 1993). It also appears that, while explicit Biospheric and Egoistic values were the strongest predictors of group membership, the IAT outperformed the NEP measure in predictive utility. Reviews of IAT results, in a variety of spheres, conclude that they capture a separate, but related, component of attitudes and behaviour when compared to explicit measures (Greenwald et al., 2009; Hofmann et al., 2005; Nosek et al., 2005) – an idea demonstrated again here.

The current results support using De Groot and Steg's (2007, 2008) value orientation measure in future research, as explicit values measured using this instrument appear to be the strongest predictor of environmentalist status and so will likely prove to be the best predictor of environmental behaviour more generally. However, we suggest that de Groot and Steg's measure could now be supplemented by our Environment IAT to identify additional links to behaviour that the explicit measures does not measure. Although the NEP was a significant predictor of group membership, investigations comparing NEP and value differences indicate

that values can also act as a stronger predictor of intentions for environmental behavioural, personal norms, and policy acceptability (Steg et al., 2011).

More generally, the results presented here demonstrate that it is possible to apply value-based stimuli when measuring implicit preferences. However, we cannot fully state that the Environment IAT is an implicit measure of values. Maio (2010) previously suggested implicit measures of values were possible, but his review also described the complication with using Good/Bad assessments of implicit measures when values are defined by measurement of importance/unimportance. The Environment IAT developed here gives a person's relative level of preference between the two extremes of Egoistic and Biospheric values at an implicit level, but additional work is required before confidently stating that the method does measure personal values. Despite consistent and clear correlations with the explicit value measures (which assessed the importance of values for the participant), and with group differences found, additional work is needed to assess using value-based stimuli in implicit tasks.

There is a range of options that application of this new Environment IAT method might open, with two broad areas briefly considered here: predicting behaviour and understanding psychological processes. Greenwald et al. (2009) argue that IAT measures are more useful when a topic is socially sensitive and, given the concern for self-presentation biases when measuring environmental views (Ewert & Galloway, 2009; Hafner et al., in prepA), the Environment IAT is ideally placed for investigative use of this construct. Although the concept of detecting "Green Fakers" (Beattie & Sale, 2009, p. 203), who hide their true beliefs, is an interesting concept, the IAT is not so much a method of identifying 'true' beliefs as though it were some kind of lie detector, but rather a measure reflecting automatic and possibly *inaccessible* (rather than hidden) beliefs (Nosek et al., 2007, p. 282). The Environment IAT could therefore provide unique insight into people with conflicting implicit and explicit preferences, evaluating whether certain specific behaviours are better linked to or predicted by implicit or explicit measures. For example, choosing to publicly recycle one's waste may be a socially sensitive act that could be explored (Barr, 2007), or even observing how an individual's uncontrolled eye movements relates to carbon-labels on commercial products (Hafner, Walker, Verplanken & Skippon, in prepB).

The Environment IAT could also explore the psychological concepts behind attitudes, decisions, and behaviour. A developing area of interest is the examination of sceptics' attitudes to climate change, and the Environment IAT may further assist investigations. For example, Corner, Whitmarsh, and Xenias (2012) presented sceptics and non-sceptics with fake newspaper articles that challenged or supported climate change, and observed how both groups developed bias against opposing views. Corner et al. (2012) also asked participants to state whether their views had changed from reading opposing views, but found little explicit evidence of 'polarisation' – a strengthening of personal opinion when challenged by external

views. The Environment IAT could evaluate how implicit environmental views may change when presented with new information, and whether automatic polarisation occurs, even when not explicitly shown. Previous work demonstrates that even after negative information on fictional social subgroups is corrected, people maintain implicit biases against the subgroup, while explicitly revising their evaluations (Gregg, Seibt, & Banaji, 2006). This could also extend to how environmentalist subgroups or individuals are viewed: implicit evaluations of people are automatic and can develop into explicit biases (Ranganath & Nosek, 2008), and IAT predictive utility increases when predicting social-group judgements (Greenwald et al., 2009).

The current approach using Egoistic/Biospheric values offers a novel approach toward IAT stimuli than previous measures, such as using low/high carbon products (Beattie & Sale, 2009) or natural/built stimuli (Schultz et al., 2004). A pilot study to evaluate potential stimuli was used to create two representative and positively valenced sets of stimuli – vital factors within IAT design (Lane et al., 2007; Teige-Mocigemba et al., 2010). However, the stimuli employed were not perfectly balanced and Biospheric stimuli were rated at a slightly higher valance than Egoistic words. But even with slightly imbalanced valance, results from the Environment IAT were consistent, theoretically sound, and predictive of actual behaviour. Improvements to the stimuli could certainly be made in the future, and additional work on designing a stronger set of stimuli may further enhance Environment IAT effects.

In all three studies, environmentalists showed stronger implicit preference for the environment than people who had not joined an environmental organization. The Environment IAT could also explore the opposite to those Biospheric-focused people who join environmental organizations: those with stronger Egoistic orientations. Egoistic values relate to self-enhancement constructs that include ambition, power, and money (Schwartz, 1994), values linked to politically right-wing voters across 20 European countries (Piurko, Schwartz, & Davidov, 2011). Applying the Environment IAT to members of right-wing political groups could provide an alternative approach to calibrating the Environment IAT, and would theoretically demonstrate stronger pro-Egoistic views.

One potential issue seen from the current results was the variation in correlations between implicit and explicit measures of environmental preferences: Study 1 laboratory tasks showed a stronger relationship than Study 2's online sample of Study 3's open day/office sample. As it may be that the uncontrolled environments (e.g. noise) presented interference with reaction-speed tasks, the variation in correlation strength should be considered in future work. One possible confound is the time of year that each study took place. Examining the time period that studies were undertaken, Study 1 was run in autumn, and Studies 2 and 3 were run in summer. Typically pleasant seasons, such as autumn, are associated with stronger implicit preferences for nature (Duffy & Verges, 2010), but no link between summer and implicit preferences has been observed. It may be the case that autumn induces more positive

associations to the environment that summer – possibly because the changing of leaves in autumn is a visual and pleasant reminder of nature, whereas the heat of summer is not directly related to perceptions of nature itself – although this is purely speculative and requires evaluation. Nonetheless, the differences in correlations between implicit and explicit environmental preferences across the studies may be linked to seasonal variations, and should be considered in future work.

Conclusions

Using the orientations of Egoistic and Biospheric values is a successful approach to designing stimuli for use in implicit methods. The Environment IAT detected large differences between committed environmentalists and the general population, showed expected correlations with explicit measures, and was a unique predictor of environmentalist status even after controlling for explicit measures of values and attitudes. The Environment IAT offers a new approach to exploring environmentally sustainable behaviours, as well as understanding views and preferences relating to sustainability and climate change. Future work may expand implicit approaches to other value orientations, and hopefully validate this approach to other fields.

References

Bar-Anan, Y., & Nosek, B. A. (2012). *A Comparative Investigation of Seven Implicit Measures of Social Cognition*. SSRN. Retrieved from http://ssrn.com/abstract=2074556 or http://dx.doi.org/10.2139/ssrn.2074556

Barr, S. (2007). Factors Influencing Environmental Attitudes and Behaviors. *Environment and Behavior, 39*(4), 435-473. doi: 10.1177/0013916505283421

Beattie, G. (2010). *Why Aren't We Saving the Planet?: A Psychologist's Perspective*: Taylor & Francis.

Beattie, G., & Sale, L. (2009). Explicit and Implicit Attitudes to Low and High Carbon Footprint Products. *The International Journal of Environmental, Cultural, Economic and Social Sustainability, 5*(4), 191-206.

Bohner, G., & Wänke, M. (2002). *Attitudes and attitude change*: Psychology Press.

Bradley, M. M., & Lang, P. J. (1999). Affective Norms for English Language Words (ANEW): Instruction Manual and Affective Ratings *Technical Report C-1*. The Center for Research in Psychophysiology: University of Florida.

Brendl, C. M., Markman, A. B., & Messner, C. (2001). How do indirect measures of evaluation work? Evaluating the inference of prejudice in the Implicit Association Test. *Journal of Personality and Social Psychology, 81*(5), 760-773. doi: 10.1037/0022-3514.81.5.760

Bruni, C. M., & Schultz, P. W. (2010). Implicit beliefs about self and nature: Evidence from an IAT game. *Journal of Environmental Psychology, 30*(1), 95-102. doi: 10.1016/j.jenvp.2009.10.004

Bruni, C. M., Chance, R. C., Schultz, P. W., & Nolan, J. M. (2012). Natural Connections: Bees Sting and Snakes Bite, But They Are Still Nature. *Environment and Behavior, 44*(2), 197-215. doi: 10.1177/0013916511402062

Casler, K., Bickel, L., & Hackett, E. (2013). Separate but equal? A comparison of participants and data gathered via Amazon's MTurk, social media, and face-to-face behavioral testing. *Computers in Human Behavior, 29*(6), 2156-2160. doi: http://dx.doi.org/10.1016/j.chb.2013.05.009

Corner, A., Whitmarsh, L., & Xenias, D. (2012). Uncertainty, scepticism and attitudes towards climate change: biased assimilation and attitude polarisation. *Climatic Change, 114*(3-4), 463-478.

De Groot, J. I. M., & Steg, L. (2007). Value Orientations and Environmental Beliefs in Five Countries: Validity of an Instrument to Measure Egoistic, Altruistic and Biospheric Value Orientations. *Journal of Cross-Cultural Psychology, 38*(3), 318-332. doi: 10.1177/0022022107300278

De Groot, J. I. M., & Steg, L. (2008). Value Orientations to Explain Beliefs Related to Environmental Significant Behavior. *Environment and Behavior, 40*(3), 330-354. doi: 10.1177/0013916506297831

De Groot, J. I. M., & Steg, L. (2009). Mean or green: which values can promote stable pro-environmental behavior? *Conservation Letters, 2*(2), 61-66. doi: 10.1111/j.1755-263X.2009.00048.x

De Groot, J. I. M., & Thøgersen, J. (2012). Values and pro-environmental behaviour. In L. Steg, A. van den burg & J. I. M. De Groot (Eds.), *Environmental Psychology: An Introduction* (pp. 141-152). Chichester, West Sussex: BPS Blackwell.

De Houwer, J. (2001). A Structural and Process Analysis of the Implicit Association Test. *Journal of Experimental Social Psychology, 37*(6), 443-451. doi: 10.1006/jesp.2000.1464

De Houwer, J., Teige-Mocigemba, S., Spruyt, A., & Moors, A. (2009). Implicit measures: A normative analysis and review. *Psychological Bulletin, 135*(3), 347-368. doi: 10.1037/a0014211

Duffy, S., & Verges, M. (2010). Forces of nature affect implicit connections with nature. *Environment and Behavior, 42*(6), 723-739.

Dunlap, R. E. (2008). The New Environmental Paradigm Scale: From Marginality to Worldwide Use. *The Journal of Environmental Education, 40*(1), 3-18. doi: 10.3200/JOEE.40.1.3-18

Dunlap, R. E., & Jones, R. E. (2002). Environmental concern: conceptual and measurement issues. In R. E. Dunlap & W. Michelson (Eds.), *Handbook of Environmental Sociology* (pp. 482-524). Westport, CT: Greenwood.

Dunlap, R. E., & Van Liere, K. D. (1978). The new environmental paradigm: A proposed measuring instrument and preliminary results. *Journal of Environmental Education, 9*, 10-19.

Dunlap, R. E., Van Liere, K. D., Mertig, A. G., & Jones, R. E. (2000). New Trends in Measuring Environmental Attitudes: Measuring Endorsement of the New Ecological Paradigm: A Revised NEP Scale. *Journal of Social Issues, 56*(3), 425-442. doi: 10.1111/0022-4537.00176

Durfee, J.L. (2006). "Social change" and "status quo" framing effects on risk perception: An exploratory experiment. *Science Communication, 27*, 459-495.

Ewert, A., & Galloway, G. (2009). Socially desirable responding in an environmental context: development of a domain specific scale. *Environmental Education Research, 15*(1), 55-70. doi: 10.1080/13504620802613504

Fischer, A., Peters, V., Vávra, J., Neebe, M., & Megyesi, B. (2011). Energy use, climate change and folk psychology: Does sustainability have a chance? Results from a qualitative study in five European countries. *Global Environmental Change, 21*(3), 1025-1034. doi: http://dx.doi.org/10.1016/j.gloenvcha.2011.04.008

Foroni, F., & Bel-Bahar, T. (2010). Picture-IAT versus Word-IAT: level of stimulus representation influences on the IAT. *European Journal of Social Psychology, 40*(2), 321-337. doi: 10.1002/ejsp.626

Goodman, J. K., Cryder, C. E., & Cheema, A. (2013). Data Collection in a Flat World: The Strengths and Weaknesses of Mechanical Turk Samples. *Journal of Behavioral Decision Making, 26*(3), 213-224. doi: 10.1002/bdm.1753

Govan, C. L., & Williams, K. D. (2004). Changing the affective valence of the stimulus items influences the IAT by re-defining the category labels. *Journal of Experimental Social Psychology, 40*(3), 357-365. doi: 10.1016/j.jesp.2003.07.002

Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. K. (1998). Measuring Individual Differences in Implicit Cognition: The Implicit Association Test. *Journal of Personality and Social Psychology, 74*(6), 1464-1480.

Greenwald, A. G., Nosek, B. A., & Banaji, M. R. (2003). Understanding and using the Implicit Association Test: I. An improved scoring algorithm. *Journal of Personality and Social Psychology, 85*(2), 197-216. doi: 10.1037/0022-3514.85.2.197

Greenwald, A. G., Poehlman, T. A., Uhlman, E. L., & Banaji, M. R. (2009). Understanding and using the Implicit Association Test: III. Meta-Analysis of predictive utility. *Journal of Personality and Social Psychology, 97*(1), 17-41. doi: 10.1037/a0015575

Gregg, A. P., Seibt, B., & Banaji, M. R. (2006). Easier done than undone: Asymmetry in the malleability of implicit preferences. *Journal of Personality and Social Psychology, 90*(1), 1-20. doi: 10.1037/0022-3514.90.1.1

Hawcroft, L. J., & Milfont, T. L. (2010). The use (and abuse) of the new environmental paradigm scale over the last 30 years: A meta-analysis. *Journal of Environmental Psychology, 30*(2), 143-158. doi: 10.1016/j.jenvp.2009.10.003

Hofmann, W., Gawronski, B., Gschwendner, T., Le, H., & Schmitt, M. (2005). A Meta-Analysis on the Correlation Between the Implicit Association Test and Explicit Self-Report Measures. *Personality and Social Psychology Bulletin, 31*(10), 1369-1385. doi: 10.1177/0146167205275613

Hurst, M., Dittmar, H., Bond, R., & Kasser, T. (2013). The relationship between materialistic values and environmental attitudes and behaviors: A meta-analysis. *Journal of Environmental Psychology, 36*(0), 257-269. doi: http://dx.doi.org/10.1016/j.jenvp.2013.09.003

Joireman, J., Barnes-Truelove, H., Duell, B. (2010). Effect of outdoor temperature, heat primes and anchoring on belief in global warming. *Journal of Environmental Psychology, 30*, 358-367.

Lane, K. A., Banaji, M. R., Nosek, B. A., & Greenwald, A. G. (2007). Understanding and Using the Implicit Association Test: IV - What we know (so far) about the method. In B. Wittenbrink & N. Schwarz (Eds.), *Implicit Measures of Attitudes* (pp. 59-102). London: Guildford Press.

Maio, G. R. (2010). Chapter 1 - Mental Representations of Social Values. In P. Z. Mark (Ed.), *Advances in experimental social psychology* (Vol. 42, pp. 1-43): Academic Press.

Mason, W., & Allon, S. (2013). Open Source, Web-based IAT. Retrieved from https://github.com/winteram/IAT

Mitchell, J. P., Nosek, B. A., & Banaji, M. R. (2003). Contextual variations in implicit evaluation. *Journal of Experimental Psychology: General, 132*(3), 455-469. doi: 10.1037/0096-3445.132.3.455

Nisbett, R. E., & Wilson, T. D. (1977). Telling more than we can konw: Verbal reports on mental processes. *Psychological Review, 84*, 231-295.

Nosek, B. A. (2005). Moderators of the Relationship Between Implicit and Explicit Evaluation. *Journal of Experimental Psychology: General, 134*(4), 565-584. doi: 10.1037/0096-3445.134.4.565

Nosek, B. A., Banaji, M. R., & Greenwald, A. G. (2002). Harvesting implicit group attitudes and beliefs from a demonstration web site. *Group Dynamics: Theory, Research, and Practice, 6*(1), 101.

Nosek, B. A., Greenwald, A. G., & Banaji, M. R. (2005). Understanding and Using the Implicit Association Test: II. Method Variables and Construct Validity *Journal of Personality and Social Psychology Bulletin, 31*(2), 166-180.

Nosek, B. A., Greenwald, A. G., & Banaji, M. R. (2007). The Implicit Association Test at age 7: A methodological and conceptual review. In J. A. Bargh (Ed.), *Automatic process in social thinking and behavior* (pp. 265-292): Psychology Press.

Nosek, B. A., & Hansen, J. J. (2008). Personalizing the Implicit Association Test increases explicit evaluation of target concepts. *European Journal of Psychological Assessment*, 24(4), 226-236.

Olson, M. A., & Fazio, R. H. (2004). Reducing the influence of extrapersonal associations on the Implicit Association Test: personalizing the IAT. *Journal of personality and social psychology*, 86(5), 653.

Oerke, B., & Bogner, F. X. (2011). Social Desirability, Environmental Attitudes, and General Ecological Behaviour in Children. *International Journal of Science Education*, 1-18. doi: 10.1080/09500693.2011.566897

Ogunnaike, O., Dunham, Y., & Banaji, M. R. (2010). The language of implicit preferences. *Journal of Experimental Social Psychology, 46*(6), 999-1003. doi: http://dx.doi.org/10.1016/j.jesp.2010.07.006

Paulhus, D. L. (Producer). (1991). Measurement and control of response bias. *Measures of personality and social psychological attitudes*.

Pearse, G. (2012). *Greenwash: Big Brands and Carbon Scams*: Black Incorporated.

Piurko, Y., Schwartz, S. H., & Davidov, E. (2011). Basic Personal Values and the Meaning of Left-Right Political Orientations in 20 Countries. *Political Psychology, 32*(4), 537-561. doi: 10.1111/j.1467-9221.2011.00828.x

Ranganath, K. A., & Nosek, B. A. (2008). Implicit Attitude Generalization Occurs Immediately; Explicit Attitude Generalization Takes Time. *Psychological Science, 19*(3), 249-254. doi: 10.1111/j.1467-9280.2008.02076.x

Schneider, W., Eschmann, A., & Zuccolotto, A. (2002). E-Prime (Version 2.0.8.90). Pittsburgh, PA: Psychology Software Tools, Inc.

Schultz, P. W., Shriver, C., Tabanico, J. J., & Khazian, A. M. (2004). Implicit connections with nature. *Journal of Environmental Psychology, 24*(1), 31-42. doi: http://dx.doi.org/10.1016/S0272-4944(03)00022-7

Schultz, P. W., & Tabanico, J. (2007). Self, Identity, and the Natural Environment: Exploring Implicit Connections With Nature. *Journal of Applied Social Psychology, 37*(6), 1219-1247. doi: 10.1111/j.1559-1816.2007.00210.x

Schwartz, S. H. (1992). Universals in the content and structure of values: Theoretical advances and empirical tests in 20 countries. *Advances in experimental social psychology, 25*(1), 1-65.

Schwartz, S. H. (1994). Are there universal aspects in the structure and contents of human values? *Journal of Social Issues, 50*(4), 19-45.

Smith, E. R., & Collins, E. C. (2009). Dual-process models: A social psychological perspective. In J. S. B. T. Evans & K. Frankish (Eds.), *In Two Minds: Dual Processes and Beyond* (pp. 197-216). Oxford: Oxford University Press.

Steg, L., De Groot, J. I. M., Dreijerink, L., Abrahamse, W., & Siero, F. (2011). General Antecedents of Personal Norms, Policy Acceptability, and Intentions: The Role of Values, Worldviews, and Environmental Concern. *Society & Natural Resources, 24*(4), 349-367. doi: 10.1080/08941920903214116

Steg, L., & Nordlund, A. M. (2012). Models to explain environmental behaviour. In L. Steg, M. Van den Burg & J. I. M. de Groot (Eds.), *Environmental Psychology: An Introduction* (pp. 185-196). Oxford: BPS Blackwell.

Stern, P. C. (1992). PSYCHOLOGICAL DIMENSIONS OF GLOBAL ENVIRONMENTAL-CHANGE. *Annual Review of Psychology, 43*, 269-302.

Stern, P. C. (2000). New Environmental Theories: Toward a Coherent Theory of Environmentally Significant Behavior. *Journal of Social Issues, 56*(3), 407-424. doi: 10.1111/0022-4537.00175

Stern, P. C., & Dietz, T. (1994). The Value Basis of Environmental Concern. *Journal of Social Issues, 50*(3), 65-84. doi: 10.1111/j.1540-4560.1994.tb02420.x

Stern, P. C., Dietz, T., & Kalof, L. (1993). Value Orientations, Gender, and Environmental Concern. *Environment and Behavior, 25*(5), 322-348. doi: 10.1177/0013916593255002

Teige-Mocigemba, S., Klauer, K. C., & Sherman, J. W. (2010). A Practical Guide to Implicit Association Test and Related Tasks. In B. Gawronski & B. K. Payne (Eds.), *Handbook of Implicit Social Cognition: Measurement, Theory and Applications* (pp. 95-116). London: The Guilford Press.

Verges, M., & Duffy, S. (2010). Connected to Birds but Not Bees: Valence Moderates Implicit Associations With Nature. *Environment and Behavior, 42*(5), 625-642. doi: 10.1177/0013916508330210

Viscusi, W.K. & Zeckhauser, R.J. (2006). The perception and valuation of the risks of climate change: A rational and behavioral blend. *Climatic Change, 77*, 151-177.